Application of the AHP-TOPSIS Method to Determine the Feasibility of Fund Loans

Penerapan Metode AHP TOPSIS untuk Menentukan Kelayakan Pinjaman Dana

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Abstract – This study aims to produce a decision support system (DSS) for the feasibility of providing loan funds as a tool and recommendation for cooperatives with several criteria as the basis for decision making, namely: business ownership status, ability, character, collateral, income, and salary. The system implementation uses the Visual Studio 2010 and Microsoft Access 2010 programming languages. This application is designed for effective and efficient decision-making. This program uses two methods, namely AHP for determining the weight of the criteria, and TOPSIS for determining to rank. This combination is designed for high-accuracy applications. The results of the pairwise comparison matrix calculation show that the weights obtained are acceptable and consistent. This application generates alternative customer data in order from the highest preference value (very feasible to get a loan) to the lowest (not feasible).

Keywords: AHP, Cooperative, DSS, Loans, TOPSIS

Abstrak - *Penelitian ini bertujuan untuk menghasilkan sistem pendukung keputusan (SPK) kelayakan pemberian pinjaman dana sebagai alat bantu dan rekomendasi bagi pihak koperasi dengan beberapa kriteria menjadi dasar pengambilan keputusan, yaitu: status kepemilikan usaha, kemampuan, karakter, agunan, penghasilan, dan gaji. Implementasi sistem menggunakan bahasa pemrograman Visual Studio 2010 dan Microsoft Access 2010. Aplikasi ini dirancang agar pengambilan keputusan efektif dan efesien. Program ini menggunakan dua metode yaitu AHP untuk penentuan bobot dari kriteria-kriteria, dan TOPSIS untuk penentuan perangkingan. Pengombinasian ini dirancang agar aplikasi memiliki akurasi tinggi. Hasil perhitungan matriks perbandingan berpasangan memiliki menunjukkan bahwa bobot yang diperoleh dapat diterima dan konsisten. Aplikasi ini menghasilkan data alternatif nasabah secara terurut mulai dari nilai preferensi yang paling tinggi (sangat layak mendapatkan pinjaman dana) hingga terendah (tidak layak)..*

Kata Kunci: *AHP, Koperasi, DSS, Pinjaman, TOPSIS*

INTRODUCTION

Savings and loan cooperatives are a type of cooperatives in Indonesia that have activities, in essence, providing services in terms of savings and loan funds in the form of money for members of the cooperative as well as the community. XYZ cooperative is a type of active savings and loan cooperative, which utilizes member savings and then distributes to members/customers again in the form of loans to set up a business or in meeting the cost of living of its customers. Loan types are based on short, medium, and long-term repayments. However, this often experiences risks and obstacles, including arrears and late payments, and not making advance payments for various reasons from customers. Therefore,

cooperatives need a policy in granting loans by setting standards to accept or reject these risks, namely by determining which loans are appropriate according to the criteria needed, including business ownership status, ability to repay loans, customer character, collateral, customer's income, and salary.

Based on the background, that the XYZ cooperative in the process of selecting proper customers and getting loans is still inaccurate so that it requires computer-based applications and appropriate methods to select several criteria in determining whether or not customers are eligible for loans. Cooperative leaders need a computer-based application and methods that are more precise, accurate, fast, and relevant for the customer data collection process to be more directed. The cooperative leader as the decision-maker must

have an effective and efficient decision support system to decide whether or not the customer is given a loan within the time frame and conditions provided by the cooperative.

In this study, researchers designed and built a decision support system for lending at the XYZ cooperatives by combining the Analytic Hierarchy Process (AHP) method and Technique for Others Reference by Similarity to Ideal Solution (TOPSIS), which is expected to help in the selection of members/customers which is more appropriate and feasible for receiving loans from the cooperative. The lending needs to take into account the risks that will occur to members because it affects the financial condition of the cooperative as well. For this reason, a computer-based decision support system is needed that can produce output in the form of information quickly related to lending criteria, whether or not a member receives a loan. The existence of a decision support system can provide information based on analysis so that it is more efficient in decision making in an organization (Budiharjo, Windarto, & Muhammad, 2017).

The AHP method is more effective for the selection of railroad technical facilities at PT. KAI Diver I Medan (Fifin, 2017). To make it easier to determine policies and strategies for the right solution to reverse logistical barriers, a decision support system is implemented by combining the AHP and TOPSIS methods. AHP for determining criteria weights and TOPSIS are used for alternative ranking stages so that decisions taken are more effective and efficient (Pornwasin & Tossapol, 2018).

The AHP-TOPSIS method to determine the priority of road improvement, the level of accuracy obtained is not too high due to the implementation of road improvement there are still personal interests in it so that it is not well-targeted in handling road repair (Firdaus, Muhammad & Nurudin, 2018). To produce a more objective ranking and appropriate recommendations for selecting the best prospective employees the AHP-TOPSIS method was applied (Santika & Handika, 2019). The AHP-TOPSIS method of accuracy in filling the pairwise comparison matrix will give more accurate results for the recommendation of PC package selection (Bhima, Rekyan. & Nurul, 2018). The describes a decision support system functions to help a manager in terms of decision making in a structured and half-structure so that it is

right on target to apply analytical models and existing data (Ahmadi, Sarjon & Jufriadif, 2018). The determination of beneficiaries of the Family of Hope Program uses the AHP and TOPSIS methods with twelve criteria being compared to find the weight values for each of these criteria. System Usability Scale (SUS) test results in this study obtained an average of 82.5 which indicates that this system belongs to the acceptable category (Hasanah, 2016).

The purpose of this study as an alternative is to assist the cooperative in determining the decision to choose a suitable customer to get a loan/credit following the criteria. Conduct an assessment of each criterion for the selection of members/customers who are eligible and make decision support to get members/customers who meet the criteria quickly and accurately.

RESEARCH METHODOLOGY

A. Decision Support System (DSS)

AHP and GIS are a combination of appropriate methods to determine data spatially and can evaluate coal deposits as an alternative power generation solution that is widely applied to increase the economic potential of mineral reserves and evaluate coal deposits because many factors affect the energy sector. The AHP method determines the weights of each criterion while the ArcGIS application is used to map and evaluate the sustainable exploitation of mineral deposits in the framework and other geospatial data (Nikolas, *et al,* 2019).

A comprehensive and innovative evaluation method is used to analyze the static voltage stability in the electric power system by utilizing EW-AHP and Fuzzy-TOPSIS. Fuzzy-TOPSIS is used to determine the bus voltage rating of the power system as the final result, taking into account the system's functionality and proportionality. The combination of these two methods is an effective approach to determine the weakest buses in the electric power system (Jiahui, *et al*, 2019). The decision support system is a process or action to achieve one goal or several goals (Christine & Yeremia, 2018). The decision support system is interactive that can present information, modeling, and manipulation of data that is useful to facilitate decision-makers in making the right decision in semi-structured and unstructured situations (Frieyadie & Surya, 2018). The decision support system can solve unstructured problems by choosing several alternatives and no one knows for sure how the decision is taken but it produces

output in the form of flexible, interactive, and adaptive information (Oktopanda. 2017).

B. Analytic Hierarchy Process (AHP)

The AHP method is used in decision making to deconstruct the complexity site planning and resource management and evaluates the value as a policy recommendation for use and rebuilding because it is a valuable source of human cultural heritage (Ma, Li, and Chan, 2018). AHP makes it easy to solve complex problems by arranging criteria hierarchically, so we can determine the weight or priority (Rahayu, Krisnanik, & Hananto, 2019). AHP and FAHP methods are used as recommendations and make it easy for companies to make decisions to solve multi-critical problems, to reduce the risk of loss for bus body manufacturing companies because many parts must be produced in a short time. Risks can occur when different companies work together to make the same product and share profits. With the application of the AHP and FAHP methods, the results are more appropriate because they can increase productivity and reduce the effect of capacity, time, and cost of capacity to make parts of a bus body (Suthep & Puntiva, 2019).

The results of the validation test conducted by the AHP method obtained the final value: 3.8 and concluded the system is feasible to be used to improve teacher performance (Sindhu, 2018). The decision support system research to select priority areas for intervention in family planning activities was built based on the website using the AHP-SMART method (Karmila, Tursina & Muhammad, 2019). E-commerce businesses using AHP need to consider websites and trademarks. The investment factor in the brand is the most important thing for forming a trademark (Tayfun, 2017). AHP method is a method for making decisions by deciding without trial and before finding a solution to the existing constraints then systematically arrange the way it works (Harli, 2016).
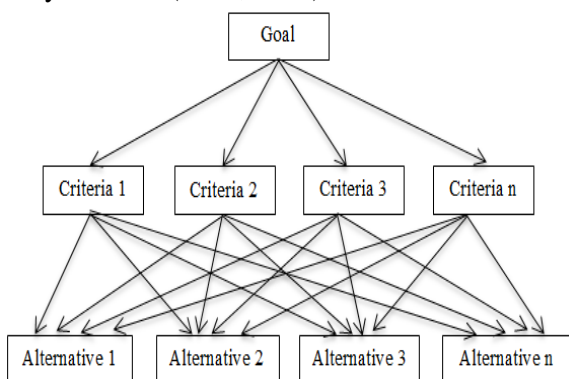

Figure 1 AHP Hierarchy Structure

Below are some AHP principles that must be understood, namely (Rizqi, Akbar, Fitrian, & Maseleno, 2018):

1. Decomposition (create a hierarchy)

A complete and complicated system is easy to understand if it has been broken down into the smallest parts.

2. Comparative judgment

Make a pairwise comparison, to obtain the scale of importance of each criterion against the other criteria.

Table 1 Pairwise Comparison Rating Scale

The intensity of interest	Definition
1	Both elements are equally important
3	Elements that one a little more important than the other elements
5	Elements which one is more important than any other element
7	One element more important than any other element One essential element than other elements
9	Values between two values adjacent consideration
2, 4, 6, 8	If the first activity in the appeal activities got the numbers j, then j has its inverse value Compared
Inverse	with i

3. Synthesis of priority

4. Logical Consistency

The steps for implementing the AHP method are as follows:

1. Define the problem and determine the solution, then arrange the hierarchy.

2. Determination of element priority.

a. Determine the pair ratio.

b. Make a pairwise comparison matrix.

3. Synthesis, things are done at this stage are:

a. In the matrix add up the values for each column.

b. The value of the column is divided by the total column to produce a normalized matrix, the formula:

$$\sum_{j=1}^{n} a_{ij} = 1 \dots\dots\dots\dots\dots\dots (1)$$

Where:

a = Pairwise comparison matrix

i = matrix row a

j = matrix column a

c. The value of each row is added up and divided by the number of elements to get the average value, the formula:

$$W_i = \frac{1}{n}\sum_{j=1}^{n} a_{ij} \dots\dots\dots\dots\dots\dots (2)$$

Where:

n = Number of criteria

W_i = Average of line I

4. Measuring Consistency, the steps are:

a. The value in the first column and the relative priority of the first element are multiplied, and so on.

b. Each row is added together.

c. From the sum of the rows, the results are divided among the relative priority elements concerned.

d. The result of the division in point (c) is summed by the number of elements, the result is called lambda (λ) max.

5. Determine the Consistency Index (CI), the formula:

$CI = (\lambda \max - n)/(n - 1)$ .... (3)

6. Calculating Consistency Ratio (CR), the formula:

$CR = CI/RI$ .... (4)

7. Check the consistency of the hierarchy. If the value is > 10%, then it needs to be improved, if the Consistency Ratio <0.1 then the calculation results are correct.

The value of $0 \leq$ ratios ≤ 0.1 is called consistent then the calculation is justified. Below can be used the random index Table 2.

Table 2 Random Index Values (RI)

n	RI
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

C. Technique Others Preference by Similarity to Ideal Solution (TOPSIS).

One of the multi-criteria decision support systems is the TOPSIS method (Nofriansyah, 2014). The TOPSIS method is an optimization technique used to identify the best combination of parameters optimally for multi-response characteristics and Analysis of Variance (ANOVA) is used to determine the most significant parameters in the overall Multi-object function and it can be concluded that the laser power is very large on the overall Multi-object function (Sampreet, *et al*, 2019). High energy use and severe levels of air pollution caused by winter warming have worsened in China in recent years. The policy of replacing coal-fired boilers with gas fuel for central heating is very important for development in China. To overcome this, the TOPSIS method is used as a recommendation for the government to make the right decisions in improving environmental quality through energy savings and reducing emissions (Jing, Yaoqi & Xiaojuan, 2019).

The decision support system developed using the TOPSIS Method can assist in making decisions in determining the best employees. Based on calculations using the TOPSIS method, it was found that V5 (Employee 5) was the best employee because it had the best value (Hertyana, 2018). The application of the TOPSIS method is designed to solve measurable problems for the financial feasibility decision support systems so that they are more objective in the assessment results taken (Mubarok, *et al*, 2019). The system produced using the TOPSIS method can recommend the selection of priority areas of stunting treatment experienced by toddlers from the largest preference value to the smallest preference value (Mahmud, Tursina & Yulianti, 2019).

In general, the TOPSIS method procedure follows steps (Dwi & Rostika, 2017):

Determine the normalized decision matrix.

Calculate the weighted normalized decision matrix.

Calculate the ideal and negative ideal solution matrices.

Calculate the distance between the values of each alternative with the positive and negative ideal solution matrices.

Calculate the preference value for each alternative.

The systematic steps of the TOPSIS method are as follows (Munawir, 2018) :

a. Starting to make a decision matrix that is evaluating alternative m in a decision matrix X based on n criteria, used with the equation 5.

b. Determine a normalized decision matrix, it can be used with the equation 6.

c. Determine the weighted normalized decision matrix, used with the equation 7.

$$X = \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \\ \\ a_m \end{array} \begin{pmatrix} x_1 & x_2 & x_3 & \dots x_n \\ x_{11} & x_{12} & x_{31} & \dots x_{n1} \\ x_{12} & x_{22} & x_{32} & \dots x_{n2} \\ x_{13} & x_{32} & x_{33} & \dots x_{n3} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & x_{m3} \dots & x_{mn} \end{pmatrix} \dots (5)$$

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}} ; \dots (6)$$

$$V_{ij} = W_j * r_{ij} \dots (7)$$

d. Determine the ideal (A +) and negative (A-) ideal solution matrices, used with the equation 8 dan 9.

$$A^+ = (y_1^+, \, y_2^+, \dots, \, y_n^+) \quad \dots\dots\dots\dots\dots\dots\dots \quad (8)$$

$$A^- = (y_1^-, \, y_2^-, \dots, \, y_n^-) \quad \dots\dots\dots\dots\dots\dots\dots \quad (9)$$

Where:

$$y_j^+ = \left\{ \begin{array}{l} \max_i y_{ij} \text{ ; if j atribut benefit} \\ \min_i y_{ij} \text{ ; if j atribut cost} \end{array} \right\}$$

$$y_j^- = \left\{ \begin{array}{l} \min_i y_{ij} \text{ ; if j atribut benefit} \\ \max_i y_{ij} \text{ ; if j atribut cost} \end{array} \right\}$$

e. Calculate the distance of the positive (D +) and negative (D-) ideal solutions. D + is the alternative distance from the positive ideal solution, used with the following equation:

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_j^+ - y_{ij})^2} \quad \dots\dots\dots\dots \quad (10)$$

D- is the alternative distance from the negative ideal solution, used with the following equation:

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_j^+)^2} \quad \dots \quad (11)$$

f. Calculation of preference values (Vi) for each alternative. used with the following equation:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad \dots\dots\dots\dots\dots\dots \quad (12)$$

g. Ranking alternatives by sorting alternatives from the largest Vi value to the smallest value. The best solution if the alternative is the best Vi value.

Collecting data by observing objects by holding direct questions and answers with the cooperative. The data needed are criteria data, alternative data, and weight data obtained from the questionnaire results. The technique of taking respondents was done using the purposive sampling method, namely selecting respondents deliberately related to the research topic. This technique is used by considering that the respondent has the competence in assessing customers who represent the company and has the authority to provide the information and data needed in the study. Respondents in this study were two people, namely supervisors and managers of the cooperative.

AHP method has a weakness in the principle of pairwise comparison, takes time, and the consistency index is fulfilled. These deficiencies make it difficult for solutions to require many choices. The TOPSIS method can be used to make practical decisions. The weights that have been obtained from the AHP calculation are used as input in the calculation of the TOPSIS method. Therefore, a model is needed to make it easier for the cooperative to determine potential customers who are eligible for a loan. The AHP method is a decision support system method that can give weight to the criteria and test its consistency. The criteria used in determining the eligibility of a loan are Business Ownership Status, Capability, Character, Collateral, Income, and Salary. The weight obtained from the AHP method becomes the input value in the TOPSIS method in sorting the alternatives to be selected. The result of the sorting is calculated for the level of accuracy. The TOPSIS method is a method that has the concept of choosing the closest alternative distance with a positive ideal solution and having the farthest distance with a negative ideal solution.

The focus of this research is to build SPK to determine the feasibility of applying for a loan using the AHP-TOPSIS method to speed up the process and produce an optimal decision value. The research framework begins with identifying problems. Identification of the problem with determining priority weights does not yet exist on the criteria selected to rank to determine the feasibility of submitting a loan then collecting data. The data used in this study are primary data through the process of observation and the relevant sources directly and secondary obtained from the theory or related material under study. The technique used to collect data is done by a literature study, interviews who know the criteria and observations.
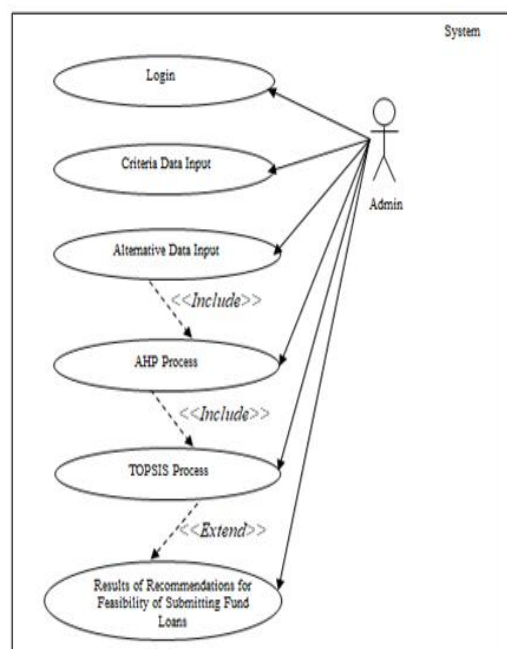

Figure 2 Use Case Diagram

The perform analysis criteria and implementation of AHP-TOPSIS to obtain an alternative ranking. AHP method is used for the weighting process then the application of the TOPSIS method is carried out to perform an alternative ranking process. The design of the use case diagram is shown in Figure 2.

In Figure 3 the following are the steps - the calculation of AHP-TOPSIS. Customer data input is performed as a determinant in the normalized matrix. Furthermore, weights are obtained to determine the ideal and negative ideal solution matrix. From the distance between the values of the solution matrix, the preferences can be determined for each alternative and then ranking. The best solution is an alternative with the largest Vi value.

RESULT AND DISCUSSION

3.1. Calculation Analysis of AHP Method

The AHP method itself is inseparable from its shortcomings, the AHP method is not effective when it is used in cases with many criteria and alternatives, therefore another method is needed to be combined with the AHP method in the order to obtain more effective results. The AHP method has the advantage of being based on a pair of comparison matrices and conducting a consistency analysis.

The AHP method is used in determining the weighting of criteria because the AHP method relies on the thinking of an expert or expert to determine the assessment of each criterion and alternative used, the element of objectivity will still exist even though the assessment is carried out by an expert because in the AHP method there is a consistency ratio assessment to assess whether an expert's assessment can be accepted with a consistent ratio value, it is still acceptable if it is used in weighting each criterion, but it is very risky when used to assess an alternative, however, the element of subjectivity will be felt if the AHP method is used to select or prioritizing the best alternative. Therefore, another method is needed to be combined with the AHP method, namely the TOPSIS method. The TOPSIS method was chosen because the TOPSIS method could complete practical decision-making. After all, its concept simple and easy to understand, the computation is efficient and can measure the relative performance of the decision alternatives. In addition, the TOPSIS method can handle alternative differences even though the differences are quite small, in the

TOPSIS method itself there is a Cost and Benefit rule to determine the rules for each criterion, with these advantages the combination of AHP and TOPSIS methods can be applied to decision support systems to produce decisions. effective, efficient, and objective.
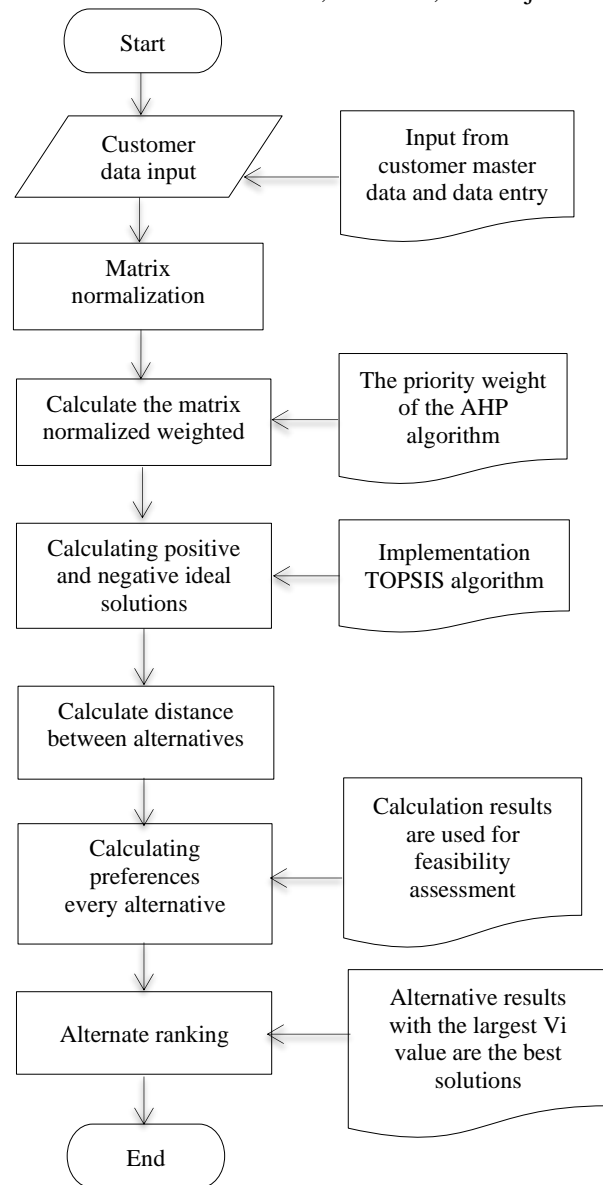
Figure 3. AHP-TOPSIS Algorithm Flowchart

In this study, the determination of the criteria weights utilizes the AHP method, while the ranking stage is done using the TOPSIS method. The criteria in determining the eligibility of applying for a loan can be seen in Table 3. Business Ownership Status (C1), Capability (C2), Character (C3), Collateral (C4), Income (C5), and Salary (C6).

After determining the criteria, then the value or weight of each criterion is made for each alternative, the next step is to analyze the system being made, the results or system output is information about the value of alternative customers that are feasible or not to get a loan and the criteria they have to serve as

recommendations for cooperatives so that they can easily and quickly make decisions for customers who are eligible for loans.
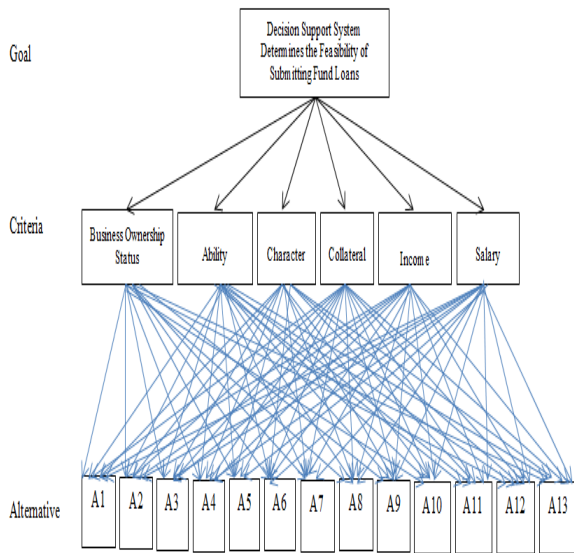

Figure 4 Hierarchical Structure for Applying for a Loan

The number data contained in Table 4 is obtained from Table 1 which is a comparison scale table of criteria values. Table 6 is the decimal value of the numeric data in Table 3.

Table 3 Pairwise Comparison Matrix

Criteria	C1	C2	C3	C4	C5	C6
C1	1	1/2	3	4	5	5
C2	2	1	3	3	3	3
C3	1/3	1/3	1	2	3	3
C4	1/4	1/3	1/2	1	2	1
C5	1/5	1/3	1/3	1/2	1	1/2
C6	1/5	1/3	1/3	1/1	2	1

Table 4 Calculation Results in Decimal Form

Criteria	C1	C2	C3	C4	C5	C6
C1	1	0.50	3	4	5	5
C2	2	1	3	3	3	3
C3	0.33	0.33	1	2	3	3
C4	0.25	0.33	0.50	1	2	1
C5	0.20	0.33	0.33	0.50	1	0.50
C6	0.20	0.33	0.33	1	2	1
Total	3.98	2.83	8.17	11.50	16.00	13.50

Table 5 Normalized Pairwise Comparison Matrices

Criteria	C1	C2	C3	C4	C5	C6
C1	0.25	0.18	0.37	0.35	0.31	0.37
C2	0.50	0.35	0.37	0.26	0.19	0.22
C3	0.08	0.12	0.12	0.17	0.19	0.22
C4	0.06	0.12	0.06	0.09	0.13	0.07
C5	0.05	0.12	0.04	0.04	0.06	0.04
C6	0.05	0.12	0.04	0.09	0.13	0.07
Total	1	1	1	1	1	1

After the number of columns is determined, the next step of the numbers in Table 6 is divided by the number of columns, resulting in a normalized matrix. In column C1, divide row C1 by the number of columns

C1=1/3.98=0.25. And so on until C6, the results are in Table 5.

Next look for the priority weight scale, through the calculation of the average row in Table 5, for example the following calculation: C1 = (0.25 + 0.18 + 0.37 + 0.35 + 0.31 + 0.37) / 6 = 0.30. Calculations are carried out until C6, so we get the priority in Table 6 below.

Table 6 Priority Weight Scale

Criteria	C1	C2	C3	C4	C5	C6	No. Rows	Priority
C1	0.25	0.18	0.37	0.35	0.31	0.37	1.83	0.30
C2	0.50	0.35	0.37	0.26	0.19	0.22	1.89	0.32
C3	0.08	0.12	0.12	0.17	0.19	0.22	0.91	0.15
C4	0.06	0.12	0.06	0.09	0.13	0.07	0.53	0.09
C5	0.05	0.12	0.04	0.04	0.06	0.04	0.35	0.06
C6	0.05	0.12	0.04	0.09	0.13	0.07	0.49	0.08
Total	1	1	1	1	1	1	6	1

The consistency matrix is shown in Table 7, examples of calculations are: C1 = (1 * 0.30) + (0.50 * 0.32) + (3 * 0.15) + (4 * 0.09) + (5 * 0.06) + (5 * 0.08) = 1, 97.

The calculation is done until C6, so we get the consistency matrix table in Table 7 below.

Table 7 Consistency Matrix

Criteria	C1	C2	C3	C4	C5	C6	Priority	Product
C1	1	0.50	3	4	5	5	0.30	1.97
C2	2	1	3	3	3	3	0.32	1.91
C3	0.33	0.33	1	2	3	3	0.15	0.96
C4	0.25	0.33	0.50	1	2	1	0.09	0.54
C5	0.20	0.33	0.33	0.50	1	0.50	0.06	0.36
C6	0.20	0.33	0.33	1	2	1	0.08	0.50

Next, determine the consistency of the vector. This is done by dividing the number of consistency matrices in Table 7 with the weighted values obtained, namely Table 6. For example 1.97 / 0.30 = 6.57, so the vector consistency is as Table 8.

Table 8 Vector Consistency

Criteria	Vector Priority	Product	Vector Consistency
C1	0.30	1.97	6.57
C2	0.32	1.91	5.97
C3	0.15	0.96	6.40
C4	0.09	0.54	6.00
C5	0.06	0.36	6.00
C6	0.08	0.50	6.25
Total			37.19

Principle of Consistency: From Table 10 we can calculate the value of lambda (λ) max, CI and CR with the formula in equations (1), (2), and (3) whose results are:

a. λ max = Number of Vector Consistency / Number of Criteria
   λ max = 37.19 / 6 = 6.20

b. CI = (λmax-n) / (n-1)
   = (6.20-6) / (6-1) = 0.04

c. CR = CI / IR (Random Index Table)
   = 0.04 / 1.24 = **0.03**

Because the CR value <0.1, the results are concluded to be consistent and accepTable. From the AHP calculation above we get the results from the value of preference weights (W) or criteria weights. Where the value of the number of rows for each element is divided by the number of matrix sizes.

Table 9 Weighting Matrix of All Normalized Criteria

Criteria	C1	C2	C3	C4	C5	C6	No. Rows	Weight Value
C1	0.25	0.18	0.37	0.35	0.31	0.37	1.83	0.30
C2	0.50	0.35	0.37	0.26	0.19	0.22	1.89	0.32
C3	0.08	0.12	0.12	0.17	0.19	0.22	0.91	0.15
C4	0.06	0.12	0.06	0.09	0.13	0.07	0.53	0.09
C5	0.05	0.12	0.04	0.04	0.06	0.04	0.35	0.06
C6	0.05	0.12	0.04	0.09	0.13	0.07	0.49	0.08
Total	1	1	1	1	1	1	6	1

Calculate the eigenvector of each paired comparison matrix. The eigenvector value is the weight of each element. This step is to synthesize options in prioritizing elements at the lowest level of the hierarchy until the achievement of goals. Synthesis of Priority is carried out using the eigenvector method to obtain relative weights for decision-making elements. The results of weight calculations are used in research modeling decision support systems for selecting customers who are eligible for loan funds. So to get the weight value of the criteria used the AHP method, which applies the concept of a pairwise comparison matrix with a comparison value based on the Saaty index value. Creating a pairwise comparison matrix, defined criteria will be weighted and compared in pairs in the form of a matrix.

3.2. Calculation Analysis of TOPSIS Method

Analysis of calculations with the SPK TOPSIS method is a calculation analysis to find the value of the solution then obtained an alternative ranking. The role of the TOPSIS method is to determine alternative ranking. In the TOPSIS method, the weighted importance of the values that become criteria is the result of the Eigen (priority) obtained from the weight calculation in the AHP method. Following is a weight table of the criteria along with the cost/benefit value:

Table 10 Cost/Benefits Matrix and Determination

Criteria	Weight (w)	Cost/Benefit
C1	0.30	Benefit
C2	0.32	Benefit
C3	0.15	Benefit
C4	0.09	Benefit
C5	0.06	Benefit
C6	0.08	Benefit

The determination of the ranking of matches for each alternative and each criterion from 1 to 5 is shown in Table 11 below:

Table 11 Match Value Ranking for Each Alternative and Every criterion

Value	Description
1	Very Inadequate
2	Not feasible
3	Decent enough
4	Worthy
5	Very decent

Next make a decision matrix, seen in Table 12.

Table 12 Value weighting interests of each Prospective Customer

Alternative	Criteria					
	C1	C2	C3	C4	C5	C6
Customer 1	5	3	4	2	4	5
Customer 2	4	4	5	2	3	2
Customer 3	2	2	1	4	3	3
Customer 4	5	4	4	1	3	2
Customer 5	4	1	5	4	5	4
Customer 6	5	2	3	4	4	3
Customer 7	3	3	4	2	4	5
Customer 8	2	5	1	4	3	5
Customer 9	5	2	4	5	2	4
Customer 10	4	4	2	3	4	1
Customer 11	4	2	4	3	2	5
Customer 12	3	3	3	4	3	4
Customer 13	1	5	5	4	1	1

Next create a normalized decision matrix R to reduce the data interval, so that the implementation of the TOPSIS method is easy and saves memory use. Calculations using alternative values of one criterion divided by the square root of the sum of each alternative per criterion.

Table 13 Normalized Decision Matrix

Alternative	C1	C2	C3	C4	C5	C6
Customer 1	0.36	0.25	0.29	0.16	0.33	0.37
Customer 2	0.29	0.33	0.37	0.16	0.25	0.15
Customer 3	0.14	0.16	0.07	0.32	0.25	0.22
Customer 4	0.36	0.33	0.29	0.08	0.25	0.15
Customer 5	0.29	0.08	0.37	0.32	0.41	0.30
Customer 6	0.36	0.16	0.22	0.32	0.33	0.22
Customer 7	0.21	0.25	0.29	0.16	0.33	0.37
Customer 8	0.14	0.41	0.07	0.32	0.25	0.37
Customer 9	0.36	0.16	0.29	0.40	0.16	0.30
Customer 10	0.29	0.33	0.14	0.24	0.33	0.07
Customer 11	0.29	0.16	0.29	0.24	0.16	0.37
Customer 12	0.21	0.25	0.22	0.32	0.25	0.30
Customer 13	0.07	0.41	0.37	0.32	0.08	0.07

Next determine the normalized decision matrix weighted Y, with the formula: $V_{ij} = W_J * r_{ij}$. The results of the normalized decision matrix calculation are weighted in the following Table 14.

Table 14 Weighted Normalized Decision Matrix

Alternative	C1	C2	C3	C4	C5	C6
Customer 1	0.11	0.08	0.04	0.01	0.02	0.03
Customer 2	0.09	0.11	0.06	0.01	0.02	0.01
Customer 3	0.04	0.05	0.01	0.03	0.02	0.02
Customer 4	0.11	0.11	0.04	0.01	0.02	0.01
Customer 5	0.09	0.03	0.06	0.03	0.02	0.02
Customer 6	0.11	0.05	0.03	0.03	0.02	0.02
Customer 7	0.06	0.08	0.04	0.01	0.02	0.03
Customer 8	0.04	0.13	0.01	0.03	0.02	0.03
Customer 9	0.11	0.05	0.04	0.04	0.01	0.02
Customer 10	0.09	0.11	0.02	0.02	0.02	0.01
Customer 11	0.09	0.05	0.04	0.02	0.01	0.03
Customer 12	0.06	0.08	0.03	0.03	0.02	0.02
Customer 13	0.02	0.13	0.06	0.03	0.01	0.01

Next determine the value of positive and negative ideal solutions, based on equations 8 and 9. To get the values in Table 16 calculated using equations 10 and 11. Next, determine the value of the proximity of each alternative to the ideal solution using equation 12.

Table 15 Results of the Positive (A +) and Negative (A -) Solution

Alternative	C1	C2	C3	C4	C5	C6
Customer 1	0.11	0.08	0.04	0.01	0.02	0.03
Customer 2	0.09	0.11	0.06	0.01	0.02	0.01
Customer 3	0.04	0.05	0.01	0.03	0.02	0.02
Customer 4	0.11	0.11	0.04	0.01	0.02	0.01
Customer 5	0.09	0.03	0.06	0.03	0.02	0.02
Customer 6	0.11	0.05	0.03	0.03	0.02	0.02
Customer 7	0.06	0.08	0.04	0.01	0.02	0.03
Customer 8	0.04	0.13	0.01	0.03	0.02	0.03
Customer 9	0.11	0.05	0.04	0.04	0.01	0.02
Customer 10	0.09	0.11	0.02	0.02	0.02	0.01
Customer 11	0.09	0.05	0.04	0.02	0.01	0.03
Customer 12	0.06	0.08	0.03	0.03	0.02	0.02
Customer 13	0.02	0.13	0.06	0.03	0.01	0.01
(A^+)	0.11	0.13	0.06	0.04	0.02	0.03
(A^-)	0.02	0.03	0.01	0.01	0.01	0,01

Table 16 Results Distance between weighted values of each alternative to the ideal positive solution (D+) and Negative (D-)

D^+		D^-	
Customer 1 (D_1^+)	0.0574	Customer 1 (D_1^-)	0.1118
Customer 2 (D_2^+)	0.0447	Customer 2 (D_2^-)	0.1140
Customer 3 (D_3^+)	0.1144	Customer 3 (D_3^-)	0.0424
Customer 4 (D_4^+)	0.0447	Customer 4 (D_4^-)	0.1232
Customer 5 (D_5^+)	0.1081	Customer 5 (D_5^-)	0.3287
Customer 6 (D_6^+)	0.0842	Customer 6 (D_6^-)	0.0979
Customer 7 (D_7^+)	0.0728	Customer 7 (D_7^-)	0.0818
Customer 8 (D_8^+)	0.0806	Customer 8 (D_8^-)	0.1126
Customer 9 (D_9^+)	0.0824	Customer 9 (D_9^-)	0.1024
Customer 10 (D_{10}^+)	0.0556	Customer 10 (D_{10}^-)	0.1063
Customer 11 (D_{11}^+)	0.0860	Customer 11 (D_{11}^-)	0.0830
Customer 12 (D_{12}^+)	0.0728	Customer 12 (D_{12}^-)	0.0781
Customer 13 (D_{13}^+)	0.0927	Customer 13 (D_{13}^-)	0.1166

Table 17 Ranking of TOPSIS decisions

Alternative	Score	Information
Customer 5 (V_5^+)	0.7525	Very decent
Customer 4 (V_4^+)	0.7338	Very decent
Customer 2 (V_2^+)	0.7183	Very decent
Customer 1 (V_1^+)	0.6608	Worthy
Customer 10 (V_{10}^+)	0.6566	Worthy
Customer 8 (V_8^+)	0.5828	Not feasible
Customer 13 (V_{13}^+)	0.5571	Not feasible
Customer 9 (V_9^+)	0.5541	Not feasible
Customer 6 (V_6^+)	0.5376	Not feasible
Customer 7 (V_7^+)	0.5291	Not feasible
Customer 12 (V_{12}^+)	0.5176	Not feasible
Customer 11 (V_{11}^+)	0.4911	Not feasible
Customer 3 (V_3^+)	0.2704	Not feasible

Table 18 Feasibility Value Measurement Tables

Appropriateness	Information
>= 0.7000	Very decent
0.6000-0.6999	Worthy
<= 0.5999	Not feasible

CONCLUSION

This research was created to assist the cooperative leadership in determining the feasibility of applying for a loan of funds, where measurements are not only taken from customer data but are taken and considered from many factors. Resolution of these problems using two methods for determining the eligibility of customers who apply for loans, namely the AHP method to determine the weight value that will be used to determine the initial input in the TOPSIS method and use the TOPSIS method for ranking alternatives so that they can make decisions more effectively, efficiently and right as a recommendation for the cooperative.

The combination of the AHP-TOPSIS method was successfully applied to the SPK determining whether or not the customer made a loan application and could be applied by examining various objects but must theoretically understand the AHP and TOPSIS method algorithms. From the calculation of the pairwise comparison matrix, the value of CR = 0.03 shows that the weight obtained is acceptable and consistent, with the criteria: business ownership status, ability to repay loans, character, collateral, income, and customer salary. The ranking results use the TOPSIS method after being sorted where the highest value is Customer 5 = 0.7525 (Very Eligible to get a loan of funds) and the lowest value is Customer 3 = 0.2704 (Not Eligible).

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